**SAGE Overview:**

SAGE is an expert system computer program designed to provide suggestions on alternative cleaning and degreasing technologies. Solvents targeted for reduction under the U.S. EPA's 33/50 program, such as chlorinated solvents, are not included as valid alternatives in this program. The program is designed to be used by state regulatory personnel, process engineers, shop supervisors or anyone looking for alternative cleaning technologies.

The goal of the program is to provide general information on viable cleaning alternatives. The intent of SAGE is to provide information to reduce the number of alternatives that must be considered. Wherever possible, only generic names for solvent or processes are used to determine the recommended alternative(s). SAGE narrows the list of alternative cleaning technologies to those technologies that best fit the application. The user can either answer questions about the product and cleaning needs, allowing the expert system to suggest the best alternatives, or go directly to the descriptions of alternative technologies. If the user only needs information about certain technologies, the information is accessible without the question and answer process.

To learn which cleaning process is best suited for a particular application, the user should be prepared to answer questions about the product and production process. The program supplies generic responses to questions that the user cannot answer. Questions include the following:

What is the material composition of the part?
Is the part metallic or non-metallic?
Does the product have a coating? Should the coating be removed?
Does the part have blind holes or a complex shape?
What type of contaminants require removal?
Is the part subject to cleanliness inspections?
What cleaning equipment is available?
What is the next process step?
Which solvents are used for part cleaning?
What is the volume of the parts to be cleaned?
Can the part withstand ultrasonic vibration? High atmospheric pressure? High pressure spray?

The program lists recommended technologies based on a scoring system that rates the technologies against the desired application. Brief summaries are available for each recommended technology. Detailed reports further describe each process and solvent application. Information concerning solvent alternatives includes material compatibility information, chemical properties, safety precautions, cleaning processes and combustibility. Material Safety Data Sheets (MSDSs) are included for all chemicals. In the descriptions about alternative processes, the user can learn about case studies of implementations, equipment costs, safety precautions, compatible cleaning solutions and particular applications. Economic summaries range in detail, but typically itemize the cost-benefits to some reasonable degree. The program also includes a NESHAP for degreasers decision tree, a state information page, a

glossary of terms and a process conversion checklist.

Stand-alone versions of the software can be downloaded free of charge from the Envirosense Web site, http://es.epa.gov/ssds/ssds.html. It is also available at http://clean.rti.org.

**Computer Requirements**
Any internet browser allows access to the SAGE Web site at http://clean.tri.org or at http://es.epa.gov/ssds/ssds.html#sage.

**Alternatives included in SAGE:**

Process Alternatives
- Abrasives
- Brushing
- CO2 Pellets
- CO2 Snow
- High Pressure Spray
- Immersion Cleaning
- Laser Ablation
- Low Pressure Spray
- Megasonics
- Plasma Cleaning
- Power Washing
- Semi-Aqueous Cleaning
- Steam
- Supercritical CO2
- Ultrasonics
- UV/Ozone Cleaning
- Wiping
- Xenon Flash Lamp

Solvent Alternatives
- Acetone
- Acidic Aqueous Solutions
- Alcohols
- Alkaline Aqueous Solutions
- Dibasic Esters
- Ethyl Lactate
- Glycol Ethers
- Neutral Aqueous Solutions
- N-Methyl Pyrrolidone
- Petroleum Distillates
- Pure Water

Terpenes

**Compliance Benefit**

Use of EPA's solvent alternatives guide allows facilities to choose alternative cleaning and degreasing technologies. Technologies that do not use toxic or ozone depleting substances (ODSs) may decrease the amounts of solvents and/or ODSs on site below any of the reporting thresholds of SARA Title III for those chemicals (40 CFR 355, 370, and 372; and Executive Order 12856). In addition, the decrease in toxic chemicals may decrease the need for a facility to obtain an air permit (40 CFR 70 and 71). Switching from a halogenated solvent (i.e. methyl chloroform, methylene chloride and perchloroethylene) may also decrease the need for a facility to meet the NESHAPs for halogenated solvent cleaning (40 CFR 63). Using a non-ODS also helps facilities meet the requirements under 40 CFR 82, Subpart D and Executive Order 12843 requiring federal agencies to maximize the use of safe alternatives to class I and class II ozone depleting substances, to the maximum extent practicable. Moreover, depending on what alternative is used the facility may decrease the amount of hazardous waste generated (i.e. no waste solvent generated).

Waste reduction is required under RCRA, 40 CFR 262. The reduction of hazardous waste may also help facilities reduce their generator status and regulatory burden (i.e. record keeping, reporting, inspections, transportation, accumulation time, emergency prevention and preparedness, and emergency response) under RCRA, 40 CFR 262.

The compliance benefits listed here are to be used as a general guideline and are not to be strictly interpreted. Actual compliance benefits will vary depending on the factors involved, such as the amount of workload involved.

**Safety and Health**
Consult your local industrial health specialist, your local health and safety personnel, and the appropriate MSDS prior to implementing this technology

**Benefits**
SAGE provides a quick but detailed reference for a variety of EPA-approved chemical and process alternatives.

**Disadvantages**
Need Internet access
Need some level of computer literacy

SAGE software is free to download and use. The program's utility far outweighs the time needed to master it.